I think this species has not heretofore been reported from Kansas, although it is a common species farther east. So far I have only found it in Sedgwick county.

Aplopappus divaricatus, Gr.—This species is very abundant in sandy regions, in the vicinity of Wichita, and, according to Smyth's "Catalogue of Flowering Plants and Ferns of Kansas," it is found in Barton county, a great portion of which is included in the sandy valley of the Arkansas. It is my intention to study this species still further.

Frœlichia gracilis, Moq.—The habitat of this species needs to be studied more carefully. I have collected only a few specimens, in sandy wastes near Wichita. Reported also from Cherokee, Barton and Dickinson counties. (Smyth, "Catalogue of Flowering Plants and Ferns of Kansas.")

Hosackia Purshiana, Benth.—This species seems to be characteristic of sandy districts, although quite common in other places, especially in western Kansas. Have collected it in Cloud and Sedgwick counties. It is also reported from Pawnee, Barton and Dickinson counties. (Smyth.)

The following species may yet be added to this list, also, after a better knowledge of them in regard to habitat is obtained:

Pentstemon acuminatus, Dougl.; Pyrrhopappus scaposus, DC.; Cyperus acuminatus, Torr.; Flaveria angustifolia, Pers.; Camelina sp.; Gramineæ, several species.

EXPERIMENTS FOR THE ARTIFICIAL DISSEMINATION OF A CONTAGIOUS DISEASE AMONG CHINCH-BUGS.

BY PROF. F. H. SNOW, OF THE UNIVERSITY OF KANSAS.

At the last annual meeting of the State Board of Agriculture I presented a paper concerning the diseases of the chinch-bug. Three of these diseases were considered, and one of them was stated to have made its appearance in portions of eastern and southern Kansas in 1888. Attention was called to the investigations of Professor S. A. Forbes, the Illinois State Entomologist, and to the experiments of Dr. Otto Lugger, of the Minnesota Agricultural Experiment Station. So late as May, 1889, Professor Forbes looked upon the artificial introduction of these diseases as having no more than a theoretical basis, and Dr. Lugger in the report of his own experiments, expressed a doubt whether the fungus disease whose germs he distributed to different localities in Minnesota in 1888, did not after all reach these localities in the natural way. Being anxious if possible to settle this question and to place in the hands of our farmers a new and more efficient weapon in their warfare against their most formidable insect foe, I sought earnestly in the spring and early summer of 1889 for the first indication of the appearance of either of the three chinch-bug maladies. In these investigations I have been heartily sustained by Secretary Mohler, who has furnished all possible aid in the accomplishment of the results finally attained. The last week in June I received a letter from Dr. J. T. Curtiss, of Dwight, Morris county, conveying the gratifying intelligence that a disease had broken out among the chinch-bugs, and that the ground in many places in fields of oats and wheat was white with the dead bugs. Dr. Curtiss stated that on June 22d he saw the first sick bugs, and in a few days dead ones. From this date to June 30th, the disease destroyed the bugs in most of the fields. Where the oats or wheat were heavy, shading the ground thoroughly, *all* the bugs died. Where the crop was thin on the ground, many bugs escaped the disease. The Doctor was at once requested to forward samples of the sick and dead

bugs for examination and experiment. He did so, and the disease proved to be one of the three to which your attention was called in my paper at the last annual meeting of this Board. I have termed this disease the "White Fungus disease," the scientific names of the little plant which produces it being *Entomophthora* and *Empusa*. This disease has for several years been known to attack the chinch-bugs, and is probably identical with the malady which first attracted the attention of Dr. Shimer in Illinois as long ago as 1866. In favorable seasons this disease often spreads in a natural way from field to field and county to county, over a considerable extent of territory, sometimes including an entire State, and even two or three adjacent States. But up to the summer of 1889 no successful method had been devised for the artificial communication of the disease from an infected district to an uninfected district. Professor Forbes had conducted culture experiments with this fungus without success, with the intention of distributing the germs of the disease, apart from the bugs themselves. This method has great promise of success in the future, but success has not yet been realized.

On receipt of the sick and dead chinch-bugs from Dr. Curtiss, I at once imprisoned a large number of healthy Douglas county bugs with the infected material, and in a few days the disease was communicated to the fresh subjects, and it was clearly established that the disease could be successfully propagated in the laboratory. During the whole course of my experiments I have found that apparently the disease is more readily communicated from the still living sick bugs than from the dead ones. Just at this time an unexpected opportunity was presented for testing this question by an experiment conducted upon a larger scale than had previously been possible. This opportunity was afforded through the enterprise of a reporter for the Lawrence *Daily Tribune*, who appeared on the scene at the right moment, and published a brief account of the appearance of a contagious disease among the chinch-bugs of Douglas county, and stated positively that the disease could be started in any field and the field soon cleared of bugs by scattering a few dead bugs, which could be obtained by sending an application to the writer of this article. In a few days I began to receive a large number of letters from no less than nine different States, begging for "diseased and deceased bugs." The magnificent opportunity thus afforded by the rather too "previous" reporter was not allowed to go unimproved, and during July and August sick and dead bugs were sent to farmers and Agricultural Experiment Stations in Kansas, Nebraska, Iowa, Missouri, Minnesota, Michigan, Indiana, Illinois, and Kentucky. The following letter of instructions accompanied each package of bugs:

DEAR SIR: Having just obtained a limited supply of diseased chinch-bugs, I inclose a small box of them for your use, on condition of your making a careful trial of them and reporting to me the result.

Please observe the following directions: Mix these bugs with ten or twenty times as many healthy bugs, and keep them together for 36 or 48 hours. Then turn them loose (both dead and living ones) on the field selected for the experiment. Watch closely for the result. A similar lot sent to Ottawa county, Kansas, two weeks ago and distributed according to the above directions, soon communicated the disease to that region. The bugs began to die in five days after the infected material had been "planted."

Please make a careful record of your proceedings, and *report to me*, as I am very anxious to discover the best possible method of spreading this disease among our farmers' most destructive enemies.

Yours truly, F. H. SNOW.

The results of this wholesale experiment have been exceedingly satisfactory, and are best presented by the following selections from an extensive correspondence:

H. J. Waters, assistant agriculturist of the Missouri Agricultural Experiment Station at Columbia, wrote July 10th: "On the station grounds here the chinch-bugs are very numerous, and are increasing with alarming rapidity. I have kept close watch for the natural appearance of the disease, but so far no bugs have shown any

signs of it. Would it be possible for you to send us a number of these insects that have died of the disease, to be used in infecting our experiment plats, and enable us to study the experiment?"

The infected material was sent out on July 18th, and on the 30th the following report was received from Mr. Waters: "Chinch-bugs have died rapidly during the last two days. Most of the dead ones are on the grass and weeds; comparatively few die on the ground. Those dying on the ground, under the shade of weeds and grass, develop a larger growth of mould than those found on the upper blades of grass. So far the disease appears to be specially fatal only in or near the localities infected July 21st, yet dead bugs covered with the mould are found in considerable numbers several rods away from the spots first infected." Four days later the following was received from the same source: "I desire to say further, that in the field first infected it is very hard to find a live chinch-bug. Two weeks ago they were there by the million. Many dead ones can be seen."

The following report was made by Professor F. M. Webster, entomologist of the Indiana Agricultural Experiment Station, and for many years one of Professor Riley's most trustworthy field-agents: "The germs of *Entomophthora* received July 20th have had the effect of destroying enough chinch-bugs to warrant the statement that they communicated the disease and established it in the field. What the ultimate result will be, and whether it will be of service to the farmer in dry weather when he most needs it, are questions yet to be settled."

The following is from a Clearwater, Minnesota, farmer, to whom infected material was sent August 5th: "Every marked hill of corn was freed of bugs before the corn was cut (1st to 15th of September), but still there were some bugs in the field, but nothing in comparison to what it was when the fungoid bugs were planted, and *they* seem to be semi-paralyzed. So firm is my belief in the efficiency of this method that I have saved about 1,000 infected bugs for next year. Please accept my thanks for the bugs, and I will hoist my cap for white fungus.—THAD. J. WOODWORTH."

The county treasurer of Worth county, Iowa, wrote as follows, September 2d: "The dead chinch-bugs you sent me did good work. I did as you directed, and in about eight days after I put them in my fifty-acre corn field the bugs began to die, and now about two-thirds of them are dead. I will now take pains to get them scattered over the county.—G. N. HAUGEN, Northwood, Iowa.

"P. S.—The weather has been very dry since I commenced the experiment, July 22d; only one shower of rain in six weeks."

The following two letters are samples of many communications from Kansas farmers:

"NAVARRE, DICKINSON CO., August 7.

"I received your deceased chinch-bugs now nearly three weeks ago. I followed the inclosed directions, only I mixed perhaps ninety or one hundred times as many as you sent. I put them in a tin quart can and left them in there for about forty-eight hours. Three days afterward I went out and looked, and to my surprise found some dead ones. I went out a week afterward and found half of them dead. I passed the other day again and could scarcely find any that had life in them, and what few there were, were sick, so that they could hardly move. I certainly feel very grateful to you for your kindness in sending me these few bugs, and I believe it will be a blessing to the country.

J. H. LENHART."

"LARNED, Aug. 1, 1889.

"DEAR SIR: Your letter of the 18th ult. with the small box of chinch-bugs came to me safely. Your directions in my experiments with the bugs were carefully followed. After the diseased ones had been with the healthy ones for forty-two hours I took them to my farm, expecting to plant them, but found I had been anticipated in the work of destruction by heavy rains. I then brought them back and put them on the farm of Capt. A. C. Morris, just south of town, where there were bugs. They seemed to perform the work whereunto they were sent, the bugs in the portion of the field infected being killed so far as I could observe. Of one thing I am well satisfied, and that is that the disease is communicable, just to what extent my experiments have not been of a character to establish.

Yours truly, SAMUEL HOUSTON."

These experiments for the artificial extension of the white-fungus disease having been thus successful, I am anxious to keep the germs of the disease alive in my laboratory continuously, so that I may be able to continue the experiment during the coming season. In order that the vitality of these germs may be more certainly preserved, I desire to obtain constant supplies of live chinch-bugs for the purpose of communicating the disease to fresh material during the winter and spring. I therefore respectfully request those interested in these experiments to furnish the desired material. It is a difficult matter to find any live bugs in Douglas county, and the farmers of the State will without doubt willingly coöperate with the writer in continuing an investigation which promises to secure to them results of great practical value.

WHO SOLD HIS WHEAT FOR $1.40?—OR AN EXAMINATION OF THE VALUE OF BLAKE'S TABLES.

BY GEO. E. CURTIS,* WASHINGTON, D. C.

In the fall of 1888 a copy of *Blake's Tables of Weather Predictions for 1889*† fell into my hands, and I was so much interested in the pamphlet in view of the considerable attention that it was receiving, that I began a review of its contents. But engagement in other duties interfered with the completion of this review, and my further attention was diverted from the subject until I recently read in the *Kansas Farmer* that "Prof. Blake is having an extensive sale for his Annual of Weather Predictions for 1890." The present time, therefore, seems to be especially opportune for making an impartial examination of the "Tables" for 1889. For, if Mr. Blake's long-range predictions have been strikingly fulfilled, the fact would furnish some ground for purchasing his "Tables" for 1890, and for following his advice as to early or late planting, the character of crop to put in, and the time to sell grain. But if, on the other hand, his most important and most confidently emphasized predictions have entirely failed, assuredly Kansas farmers will wish to know this in order to escape following blind leaders of the blind. Manifestly, therefore, the most rational thing to do is to make such an examination of the "Tables" as will enable us to determine their claim to our attention. In common with all professional meteorologists with whom I am acquainted, I am ready to welcome any more powerful methods of weather prediction than are now known to the scientific world; but for some reason Mr. Blake has not seen fit to publish the detailed methods that he has employed in calculating his "Tables," and he has given only vague references to "four large account books filled with formulas and figures," and to the discovery of a mysterious "universal law of axial rotation," which has been the "stepping-stone" to his success.

If these discoveries are genuine astronomical or physical laws, then the highest honors would follow their publication, and hence the present secresy justly but unfortunately throws upon them a suspicion which they ought not to predeserve. In lieu, therefore, of studying the methods by which the "Tables" were constructed, there remains only to determine their success, by comparing the predicted with the actual weather; and it is to such a comparison that I invite all who are yet uncertain as to whether in the present state of knowledge they do well to trust in any long-range predictions.

*Lately Professor of Mathematics, Washburn College, Topeka, Kansas.

†Blake's Tables of Weather Predictions for each State for each month of 1889, according to mathematical calculations based on astronomical laws: C. C. Blake, Topeka, Kansas.